SOME STATISTICS OF DIABETES MELLITUS.

By N. S. Davis, Jr., A.M., M.D.

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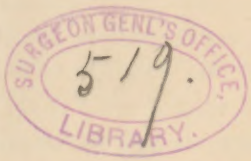

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During the last few years, as cases of diabetes mellitus have come to me, and as I have watched those under treatment, the impression has grown that there was a seasonal variation in their occurrence and severity which is not mentioned either in text-books or monographs. I was therefore prompted to study carefully the statistics of such cases as I have records of. These amounted to fifty-five in all. About one-third of them have been under observation almost continuously, for from two and one-half to seven years. Most of them have been seen at least once a month, and during exacerbations two or three times a month. A few gaps of from one month to six or seven have occurred in all those longest under observation. The other two-thirds had been watched closely for from six weeks to six months. In preparing the following Chart 1, the proportion of times that sugar has occurred in the urine to the total number of observations made on these cases in a given month has been compared. For example, in the Januarys of the last seven years sixty analyses of diabetic urine have been made and sugar has been found fourteen times. The relation of positive to negative results is therefore 1.4 to 6.6. Chart 1 prepared in this way shows the correctness of my impression that there is a seasonal variation in the occurrence or recurrence of glycosuria. As will be observed on the chart, glycosuria has occurred three times as often in March and April as in January, four times as often in July and a little more than

three times as often in November. It occurs least frequently in December, January and February. It is notably less common in May than in April or July. Its frequency of occur-

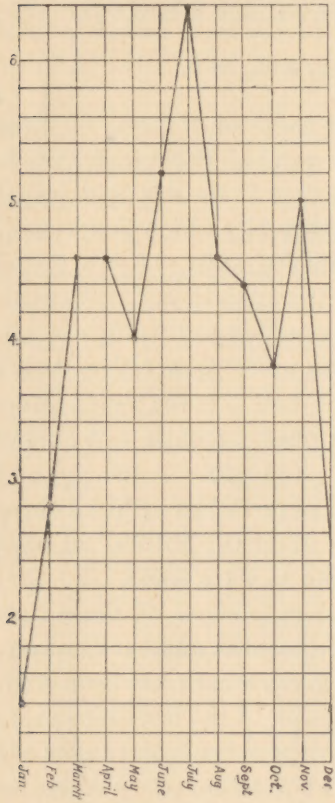

CHART I.

Relative frequency of occurrence by months in chronic diabetes. Average from 55 cases.

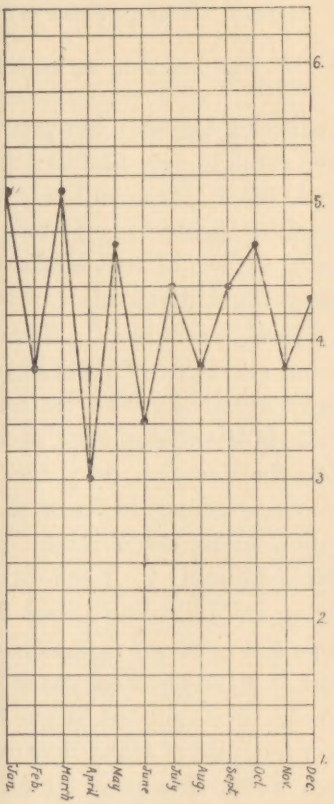

CHART V.

Relative frequency by months of deaths from diabetes during 29 years in Chicago.

rence is seen to diminish during August, September and October, culminating in the latter month to rise abruptly in

November and to fall as abruptly in December. The same facts can be stated in figures; the proportion of positive to negative observations in each month of the year are as follows:

January	1.4 to 6.6
February	2.8 " 4.2
March	4.6 " 2.4
April	4.6 " 2.4
May	4. " 3.
June	5.2 " 1.8
July	6.1 " .9
August	4.6 " 2.4
September	4.4 " 2.6
October	3.7 " 3.3
November	5.0 " 2.0
December	2.5 " 4.5

It is interesting to compare with Chart 1, which is a composite of the ratios obtained from fifty-five cases, charts made in the same way of a few individual cases. Charts, 2, 3 and 4 illustrate the marked similarity in seasonal variations between the three cases that I have had longest under treatment and the general average of cases as shown in Chart 1. The case which Chart 2 represents has been under observation for seven years and has been seen during that time at least once a month, except on two occasions when he was absent from home for from two to three months. Chart 3 represents a case that was under observation four years. There were six months in the middle of this period when he was not seen by me. The third case represented by Chart 4 has been watched for more than three years, and during that time he has been seen at least once a month, except for two and one half months in the third year. It will be observed that these charts correspond almost precisely with Chart 1; the increases in frequency of occurrence of sugar in the urine occurs in

March or April, again most notably in July, and again though to a less extent, in October or November. The periods of its least frequent occurrence are December, January and May. It is interesting to note that the time of beginning of diabetes in those cases in which I could trace with probable accuracy its commencement corresponds to the periods of frequent occurrence as shown in Chart 1. It began in one-half the cases in July, in about one-fifth in April or November. The coinciding results of these statistics of individual chronic cases, and of the average of fifty-

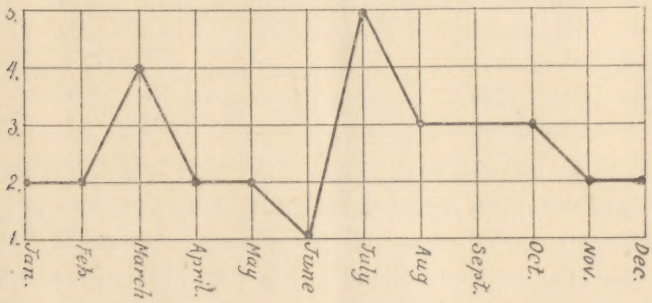

CHART II.

Relative frequency of occurrence of glycosuria in case of S., under observation for seven years.

five cases, and of the time of beginning of the disease in the twenty-four cases in which it could be accurately traced, are quite convincing of a seasonal variation in the severity of diabetes, at least in this locality. No hypothetical explanation of these facts that I have been able to devise is satisfactory to myself. During the last year and a half I have warned patients of the greater danger of exacerbation of their disease in March, April, July and November, and of the need of greater dietary care at these times. The study of these fifty-five cases suggested that possibly similar results might be obtained from a study of the mortality

tables of Chicago. The printed mortality reports afford the needed statistics from 1864 to 1893 inclusive. It may be

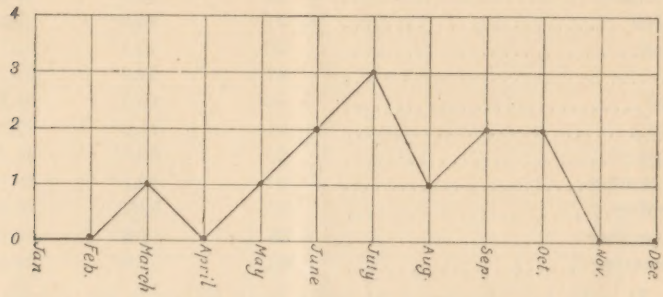

CHART III.

Relative frequency of occurrence of glycosuria in case of McK., under observation for four years.

interesting to note that the first recorded death from diabetes in Chicago was in January, 1864, and it was the only

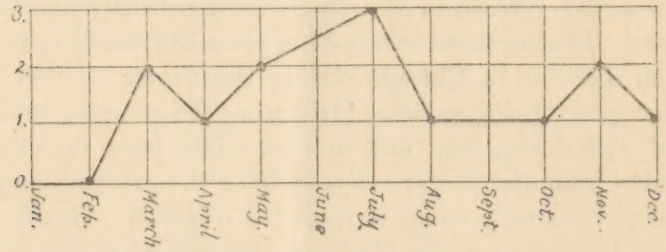

CHART IV.

Relative frequency of occurrence of glycosuria in case of J., under observation more than three years.

one that occurred in that year. Chart 5 shows the relative mortality by months during the twenty-nine years from 1864 to 1893. The same facts can be stated in figures:

Months.	Total Mortality by months from 1864 to 1893.	Mean Temperature Fahrenheit.	Mean Barometric Pressure.
January	51	24.0°	29.31
February	38	26.0°	29.30
March	51	33.8°	29.25
April	30	45.2°	29.21
May	47	54.9°	29.21
June	34	65.3°	29.20
July	44	71.5°	29.23
August	38	69.5°	29.24
September	44	62.1°	29.28
October	47	50.7°	29.28
November	38	37.2°	29.28
December	43	27.2°	29.29

It will be observed at once that there is no similarity between Charts 1 and 5,—in other words that the study of recurring glycosuria in the fifty-five cases does not correspond in its seasonal variations with the variations in mortality from the same disease. The mortality is higher about every other month, but averages a little higher during the winter months than at other times, though this is the season when I observed glycosuria recurring least frequently in chronic cases. During these twenty-nine years 132 deaths occurred from diabetes in Chicago during the winter months, 128 during the spring months, 116 during the summer months, and 129 during the fall months. The least number of deaths from diabetes are seen to be in the summer months, when glycosouria seems to recur the oftenest. This fact in regard to the mortality of the disease is more marked if we place together the deaths from the disease in the four coldest and bleakest months of the year, namely, December, January, February and March. For these months there were 183 deaths, for the four following months 155, and for the next four 167. It may be interesting, also, to compare with Chart 5, Charts 6 and 7, made from less complete statistics of mortality in Philadelphia* and Cincinnati.† The

*From statistics of six years. †From statistics of eleven years.

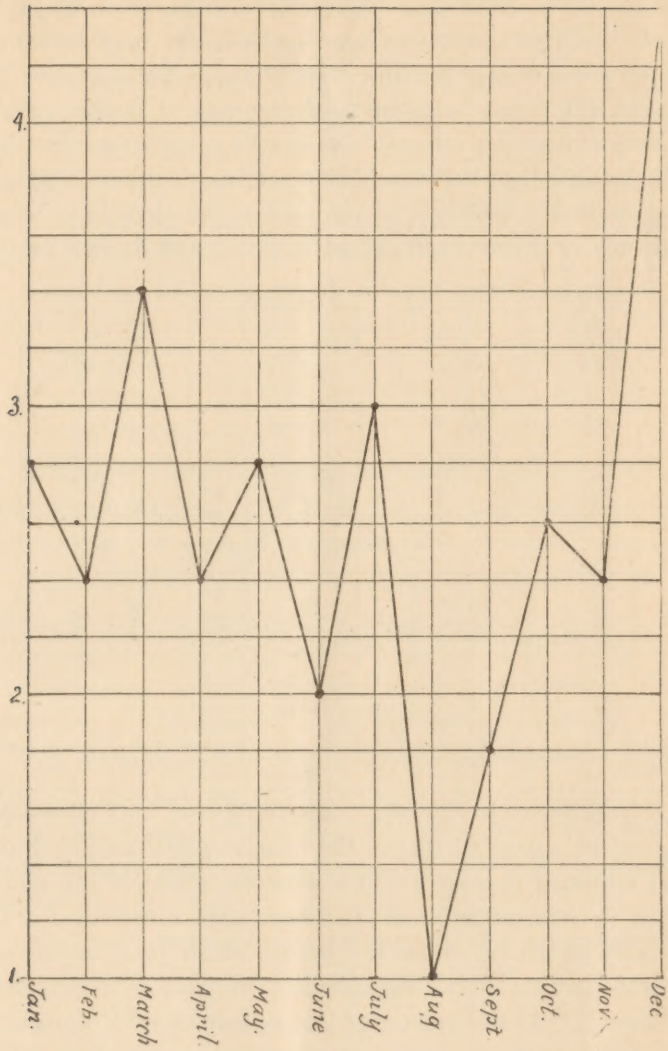

CHART VI.

Relative frequency by months of deaths from diabetes during six years in Philadelphia.

same seasonal variations are observable in these as in the chart of Chicago's mortality. Indeed, the increased mortality in the winter months is still more noticeable. The marked difference between the frequency of deaths and the exacerbations of a chronic disease like diabetes illustrates well the fact that there need be no close relationship between the two; for in diabetes, as in many other chronic ailments, death many times results from intercurrent diseases rather

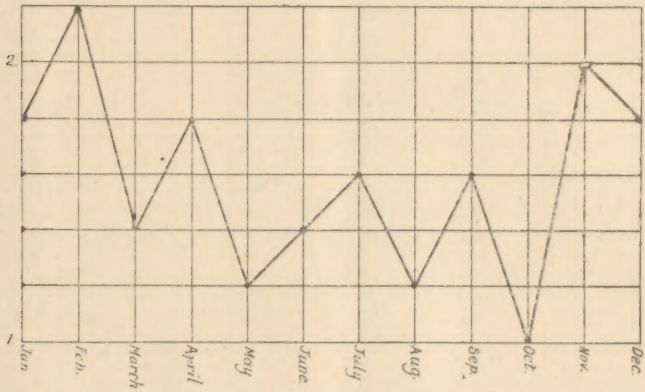

CHART VII.

Relative frequency by months of deaths from diabetes during eleven years in Cincinnati.

than from the primary one. These figures and charts correspond in a general way to the conclusions drawn by Purdy from his most thorough and interesting study of the United States Census statistics of diabetes. He concludes: "The territory which furnishes the lowest mean temperature and highest altitude also furnishes the highest mortality from diabetes." * If the mortality is greatest in cold regions, we might expect that it would be greatest in any given region during the coldest months; and if greatest at high alti-

*Purdy—Diabetes—Students' and Physicians' Ready Reference Series.

tudes, that it would be greatest when barometric pressure averaged low. Barometric pressure varies so little in one locality month by month that it probably does not influence death rate as average temperature may. The influence of temperature is more clearly shown by comparing the mean temperature of seasons during the twenty-nine years covered by Chicago's mortality table, with the mortality from diabetes during those seasons.

	Mean Temperature.	Mean Barometric Pressure.	Deaths.
Winter,	26° F.	29.30	132
Spring,	45°	29.22	128
Summer,	69°	29.23	116
Autumn,	50°	29.28	129

Althougth the variations in barometric pressure are only eight-hundredths of one inch, the highest mean seasonal pressures correspond to the greatest death rate.

It is probable that the mortality of diabetes is greatly influenced by the pulmonary complications which are a common cause of death in this affection, and therefore the mortality statistics do not correspond with the statistics of the recurrence of the disease or its variations in severity.

The following Chart 8 and figures show the relative mortality of diabetes per 100,000 inhabitants in Chicago by years. It is especially interesting because of the demonstrable sudden and great increase in mortality that occurs after 1875.

In 1864	mortality	was	.60	per	100,000	inhabitants
" 1865	"	"	.50	"	"	"
" 1866	"	"	.4	"	"	"
" 1867	"	"	1.36	"	"	"
" 1868	"	"	.4	"	"	"
" 1869	"	"	1.5	"	"	"
" 1870	"	"	1.	"	"	"

In 1871	mortality	was	1.2	per	100,000	inhabitants.
" 1872	"	"	.5	"	"	"
" 1873	"	"	.5	"	"	"
" 1874	"	"	1.3	"	"	"
" 1875	"	"	1.25	"	"	"
" 1676	"	"	1.	"	"	"
" 1877	"	"	1.9	"	"	"
" 1878	"	"	2.5	"	"	"
" 1879	"	"	3.5	"	"	"
" 1880	"	"	3.6	"	"	"
" 1881	"	"	2.8	"	"	"
" 1882	"	"	2.3	"	"	"
' 1883	"	"	1.7	"	"	"
" 1884	"	"	2.5	"	"	"
" 1885	"	"	4.2	"	"	"
" 1886	"	"	2.5	"	"	"
" 1887	"	"	4.5	"	"	"
" 1888	"	"	4.	"	"	"
" 1889	"	"	2.8	"	"	"
" 1890	"	"	3.	"	"	"
" 1891	"	"	3.8	"	"	"
" 1892	"	"	2.9	"	"	"

From 1864 to 1875 the average mortality per 100,000 inhabitants is .92 and ranges from .5 to 1.5. From 1876 to 1892 the average is 2.8, and ranges from 1.7 to 4.5. The increases which this chart shows do not correspond to increases in population, for between 1886 and 1888 the mortality from diabetes is greatest and the gain in population about one-seventh. From 1884 to 1886 was the next highest mortality, and the gain in population was about one-eighth. From 1890 to 1892 was the next highest, and the gain in population was one-sixth. From 1871 to 1873 the mortality was very low, but the gain in population was about one-seventh. From 1885 to 1886 occurred the greatest fall in the mortality and the increase in population was about one-fifteenth.

From 1879 to 1883 there was a steady and considerable fall in morality and a gain in population of more than one-third, or by years from 1879 to 1880 about one-sixth, from 1880

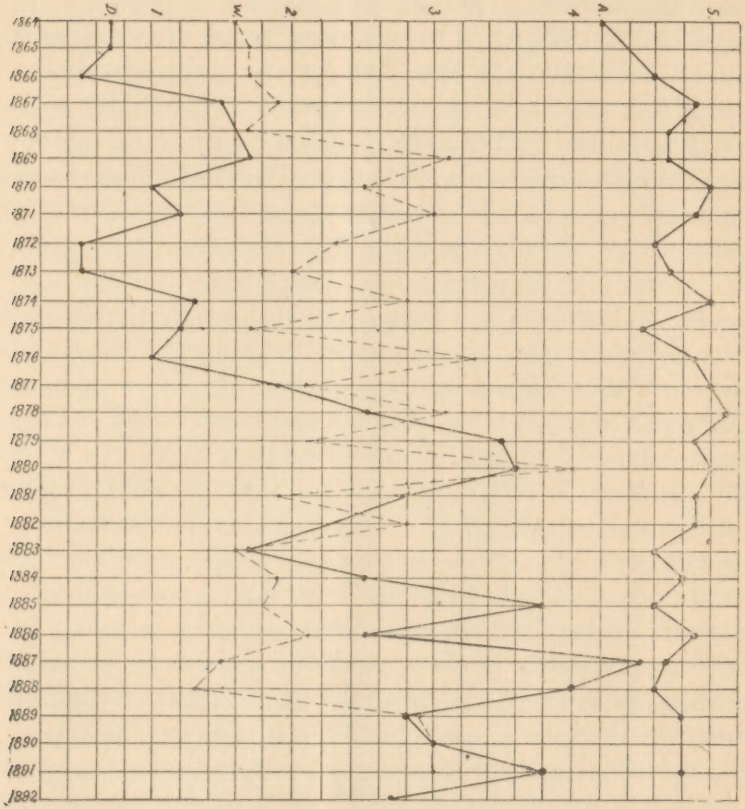

CHART VIII.

Relation of annual death rate from diabetes (D) in Chicago to annual mean temperature (A) and mean midwinter temperature (W).

to 1882 about one-seventh, and 1882 to 1883 about one-sixth. Nor does the mortality correspond to the mean

annual temperatures, or the mean temperature of the coldest month, as the two upper lines in Chart 8 show. The uppermost one shows the variation in mean annual temperature during the various years; the broken line the mean temperature for January in each year. It will be observed that in 1872 and 1873, when the mortality is low, that the mean annual temperature is moderate and the mean winter temperature rather low. In 1866 and 1868 the mortality is also low, but in 1866 the mean annual temperature and the mean winter temperature are both low; but in 1868 the mean annual temperature is moderate though the mean winter temperature is low. In 1883 the rate of mortality from diabetes is low, the mean annual temperature and the mean winter temperature are low; in 1886 the mortality is also low, the mean annual temperature is moderately high and the mean winter temperature moderate. In 1889 the mortality is also low, but the mean annual temperature and the mean winter temperature are moderately high. In 1867 the mortality is relatively high for the first eleven years represented in this chart, the mean annual temperature is moderately high, and the mean winter temperature low. In 1869 the mortality is relatively high, the mean annual temperature moderate, the mean winter temperature high. In 1879 the mortality is great, the mean annual temperature moderately high, the mean winter temperature moderately low. In 1885 the mortality is high, the mean winter temperature is low and the mean annual temperature moderately low. The same is true of 1887. It is evident, therefore, that there is no relationship between mortality variations and variations in mean annual or winter temperature. The great increase in mortality from diabetes in Chicago after 1876 cannot be accounted for by either unusually rapid increase in population or variations of mean temperature.

It would be interesting if statistics were accessible to compare the annual mortality with changes in destiny of population, that is, number of inhabitants per square mile.

The mean mortality in Chicago from 1864 to 1892 is 2.02 per 100,000 inhabitants. According to Davidson* and Hirsch† in Australia it is about 2, in Scotland 1, in England about 5, in Ireland about 2. In other localities these authors base their statements of mortality upon the total number of deaths, rather than upon the number of inhabitants. In Norway it is said to be 2.5 per 1,000 of total mortality; in Germany 1. By the United States census for 1870, 1.7; for 1880, 1.9. In England 1.25; in Ireland .74; in Schleswig-Holstein .65; Berlin .94; Chemnitz 1; Frankfort-on-Main 1.6; Vurzburg 1.2; Brussels .6. Purdy has shown that in different states in this country the mortality from diabetes per 1,000 of total mortality varies from .55 in Alabama to 6.36 in Vermont.‡ In Illinois it is 2.11, in Iowa 2.42, in Indiana 2.72, Wisconsin 2.81, Michigan 2.68, Minnesota 1.99.

From a further study of the case records from which these statistics have been drawn, several other interesting conclusions can be adduced, but they are not novel. For example, in mild cases variations in the amount of sugar in the urine in the same month are great, or it may be present or disappear and reappear several times in one month, though the patient maintains the same diet and treatment continuously. It is noticeable also that there is no relationship between the specific gravity of the urine and the percentage of sugar in it. For instance, taking figures from one case, with specific gravities of 1025 and 1028 there was a trace of sugar, with a specific gravity of 1029 none, with a spe-

*Davidson—Geographical Pathology.
†Hirsch—Handbook of Geographical and Historical Pathology.
‡Purdy—Diabetes, Physicians' and Students' Ready Reference Series.

cific gravity of 1030 2 per cent., with a specific gravity of 1035 1 per cent., a specific gravity of 1038 1.8 per cent., with a specific gravity 1040 1.8, a specific gravity 1041 1.5 per cent., a specific gravity of 1043 1.8 per cent., a specific gravity of 1045 1.5 per cent. In other cases a specific gravity of 1043 was accompanied by 2 per cent. of sugar, a specific gravity of 1048 by 1.5 per cent., a specific gravity of 1038 by 2 per cent., again 1038 by 1 per cent., and 1030 by 2 per cent., 1040 by 3 per cent. and 1028 by 3 per cent. The feelings of weakness and malaise, so characteristic of the diabetic state are correlated with the total amount of sugar eliminated, but very different quantities will produce similar effects in different individuals. For example, in one patient trifling weakness is noticed when 7.5 grams are voided daily, and increases when 3.75 are voided, and is very marked when from 20 to 75 are voided daily. In another case moderate general discomfort of the characteristic kind is felt while from 7 to 10 grams are voided, but becomes intense when from 40 to 120 are passed. In a third case equally intense symptoms accompany the passage of only 1.3 grams daily and are moderately severe when only .4 to .5 grams are voided. These variations are easily understood if the fact is appreciated that an excess of sugar in the blood and urine is only one factor in the diabetic state, and that others little understood, which result from the malnutrition of the disease are as important or perhaps more important causative factors of the general symptoms characteristic of the disease.